

Linux For Space

Mission Begins



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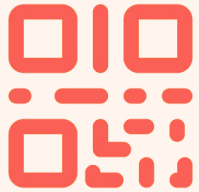
Lukáš Mázl

16.9.2022

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#Linux4Space2022

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What is Linux For Space?

- Collaborative open source project.
- It was founded with the intention of creating an open source Yocto based Linux distribution suitable for the space applications.
- The project brings together all the stakeholders: the software and hardware developers, the suppliers, and technology companies.
- The Linux4Space is designed to be compliant with the ESA Standards (ECSS - European Cooperation for Space Standardization) and it is based on community defined requirements.

The Linux For Space has started in February 2022.



Who are we?

- Embedded Linux specialists at Technical University of Liberec.
- From 2017 we have delivered 4 fully customized embedded Linux distribution to our industry partners working mostly in automotive.
- In our last project called BusKit we have implemented full CI/CD chain for Yocto based development called *Embedded TULChain*.
- We are experienced Requirements engineers with more than 20 years industry experience.
- We have consulted several space Linux solutions.



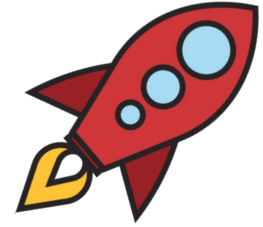
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Why are you here?

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Why Linux For Space just now?



- Hardware starts to be ready for Linux.
- More and more Linuxes in space.
- Each of them is customized by HW supplier.
- Now we face similar situation as Automotive Linux +/-5 years back ago.

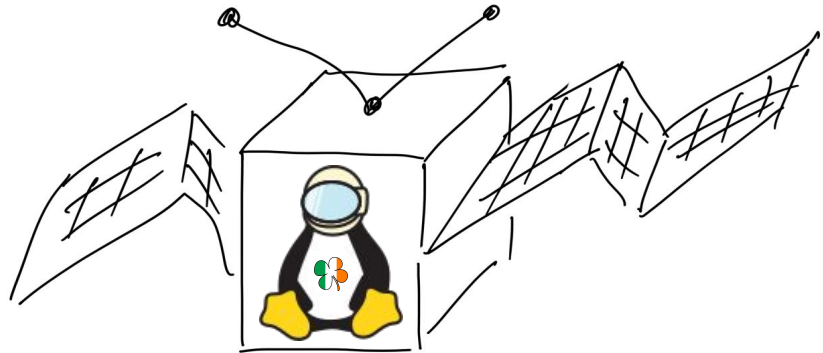
Now it is the right time to build together the space ready Linux distribution!



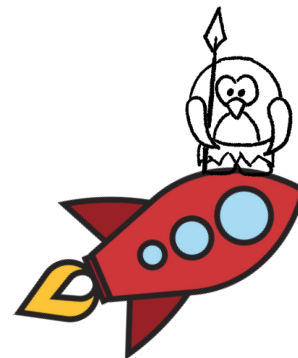
What can bring the open space ready distribution?

- Space is strictly defined use-case.
- The system has to fill typical set of requirements.
- The system shall be compliant to space industry standards.

Why to reinvent the wheel with each new cubesat?



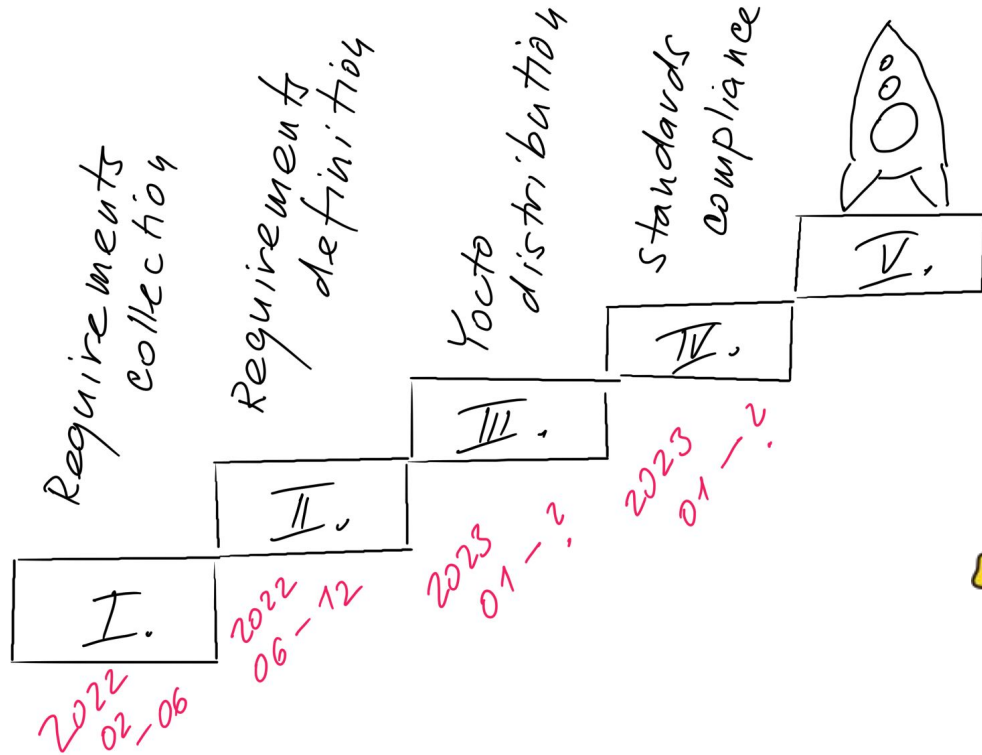
Linux in space history



Name	Operator	Launch date	Description
QuakeSat	QuakeFinder LLC	2003	Diamond Systems Prometheus PC/104 x86 CPU module with Red Hat Linux
MidSTAR-1	United States Naval Academy	2007	ARM Linux on a payload controller
STRaND-1	Surrey Space Centre	2013	Digi-Wi9C with μ Clinux and Google Nexus One with Android
Falcon 9, Dragon	SpaceX	Several since 2010	Multiple COTS computers, custom Linux 3.2 with real-time patches



The plan



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What defines the space use-case?

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What defines the space use-case?

- Radiation, a lot of radiation.
- Limited power, really limited power.
- High reliability required.
- No GUI.
- No CLI.
- If terminal, then on telemetry.
- Latency.
- Overheating.
- Hard maintenance - the systems shall work autonomously.



Mission 1: The Requirements collection

- The main goal:

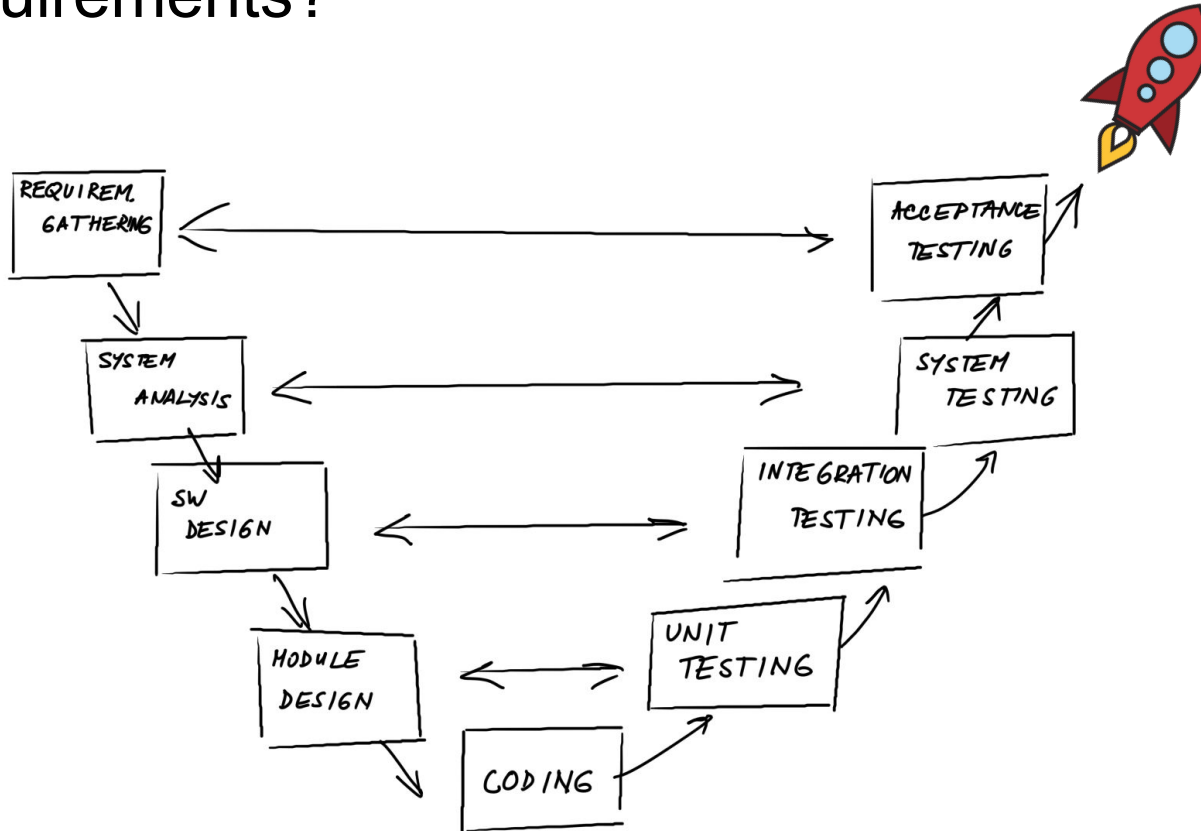
Convert use-case to set of well defined requirements.

- Regular meetings from February 2022.
- The outcome: Linux4Space requirements, ver. 001
- The document structure based on ECSS Standard (functional, interface, operational, configuration, design, verification).

[ECSS-E-ST-10-06](#): Technical requirements specification.



Why requirements?



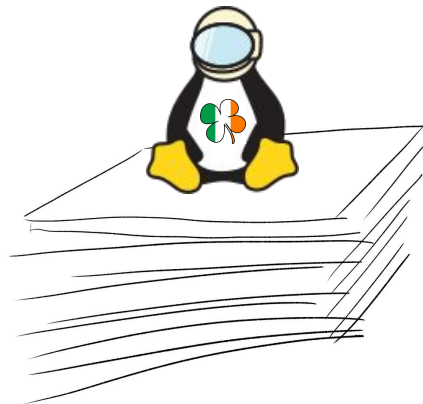
Requirements ver. 001 - Selected examples

- Radiation:
 - The system shall switch off immediately.
 - The system works in several parallel instances.
 - The filesystems shall mostly work in read-only mode.
- Interfaces:
 - SpaceWire, SpaceFibre
 - CubeSat Space Protocol
- Power constraints:
 - The system shall have a configuration to define the process with a certain power budget.

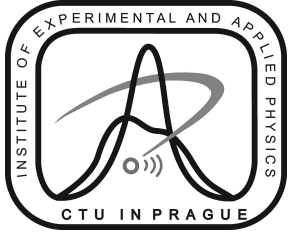


What do we have

- linux4space.org
- Requirements version 001 (available online).
- Dictionary (available online).
- The first Yocto implementation strategy draft (not yet online).
- Regular community meetings.



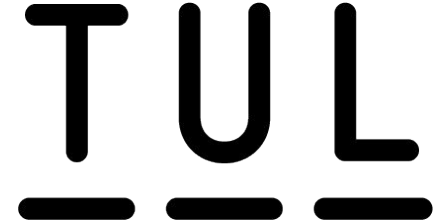
Who is already involved?



Payloads for
space.
Several running
space
realizations.
Requirements
collection.



VZLUSAT-2 with
Linux currently in
space.
Requirements
collection.

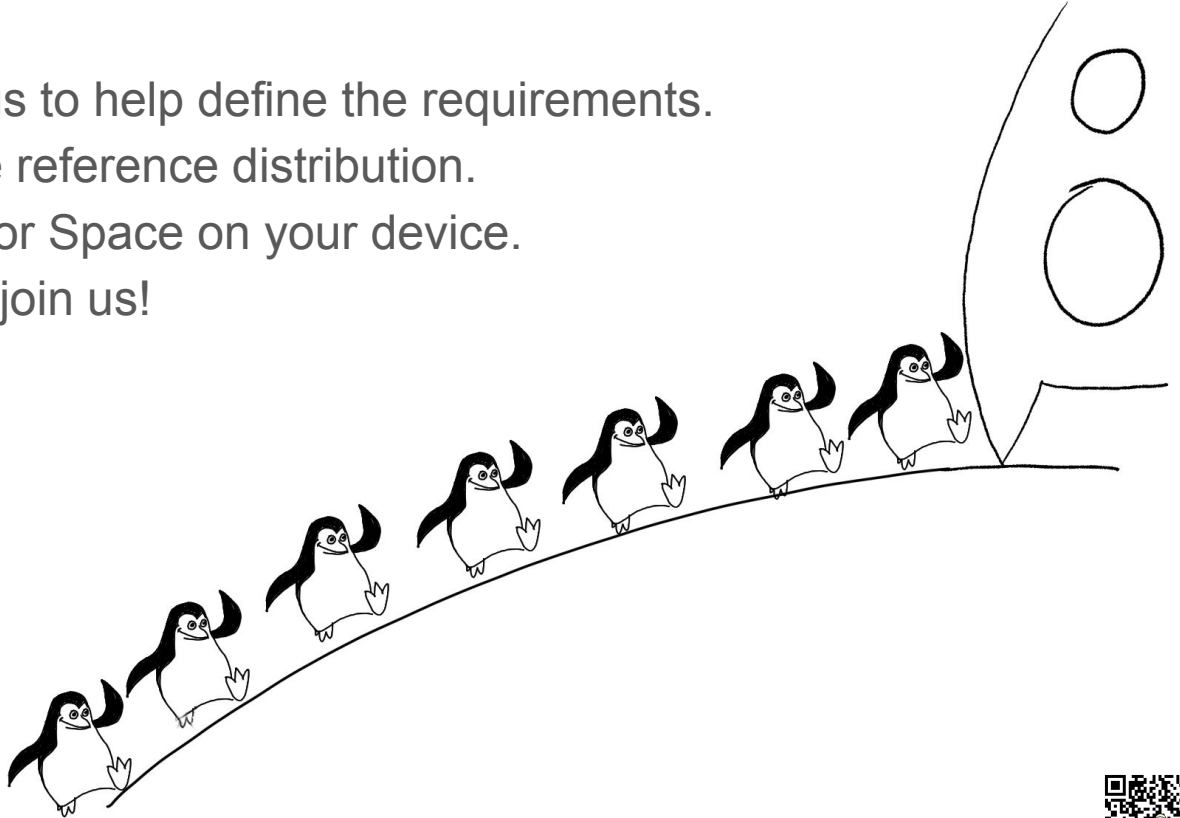


Web, project
organization,
propagation and
management
Requirements
collection
Project
implementation



What has to be done? How can I participate?

- You can join the meetings to help define the requirements.
- You can help to build the reference distribution.
- You can test the Linux For Space on your device.
- Everyone is welcome to join us!



Yocto Implementation details: The Embedded TULChain

- The full CI/CD for embedded Linux development.
- Based on Gitlab.
- Containers for compilation and image preparation.
- Automated compilation and tests after commit.
- Fully traceable system from the initial configuration to final image.
- All the tests stored in database.
- Defined as IaaS, portable.

The Embedded TULChain is the outcome of the BusKit project supported by the Czech Technology Agency.



Everyone is welcome!

- Next community meeting: Thursday 22th of September at 15:00.
- Scan the code to get invitation.



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**How much do you like the
idea of Linux For Space?**

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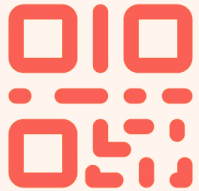
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**Would you like to join the
community?**

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Everyone is welcome!

